




## Drainage Reports

# ZONING DRAINAGE REPORT

## Estates at Jenan

Prepared for:

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November 2019

# ZONING DRAINAGE REPORT

ESTATES AT JENAN

NOVEMBER 2019

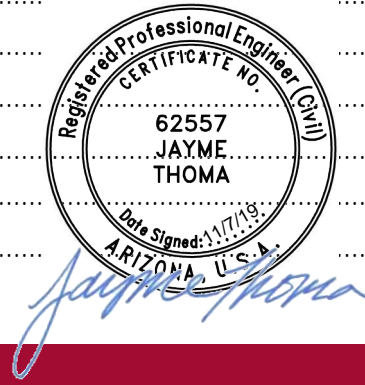
Prepared By:



**Kimley»Horn**

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## INTRODUCTION

### SITE LOCATION

This Zoning Drainage Report has been prepared for the proposed Estates at Jenan (the Site). The Site is bound to the east by private properties and North 74<sup>th</sup> Place, to the west by an existing development and North Scottsdale United Methodist Church, to the north by East Jenan Drive and south by an existing development, Cholla Estates. The area surrounding the Site is developed with primarily single-family homes. The Site is located within Section 23 of Township 3 North, Range 4 East of the Gila and Salt River Base and Meridian, Maricopa County, Arizona. Refer to Figure 1 for the Location Map.

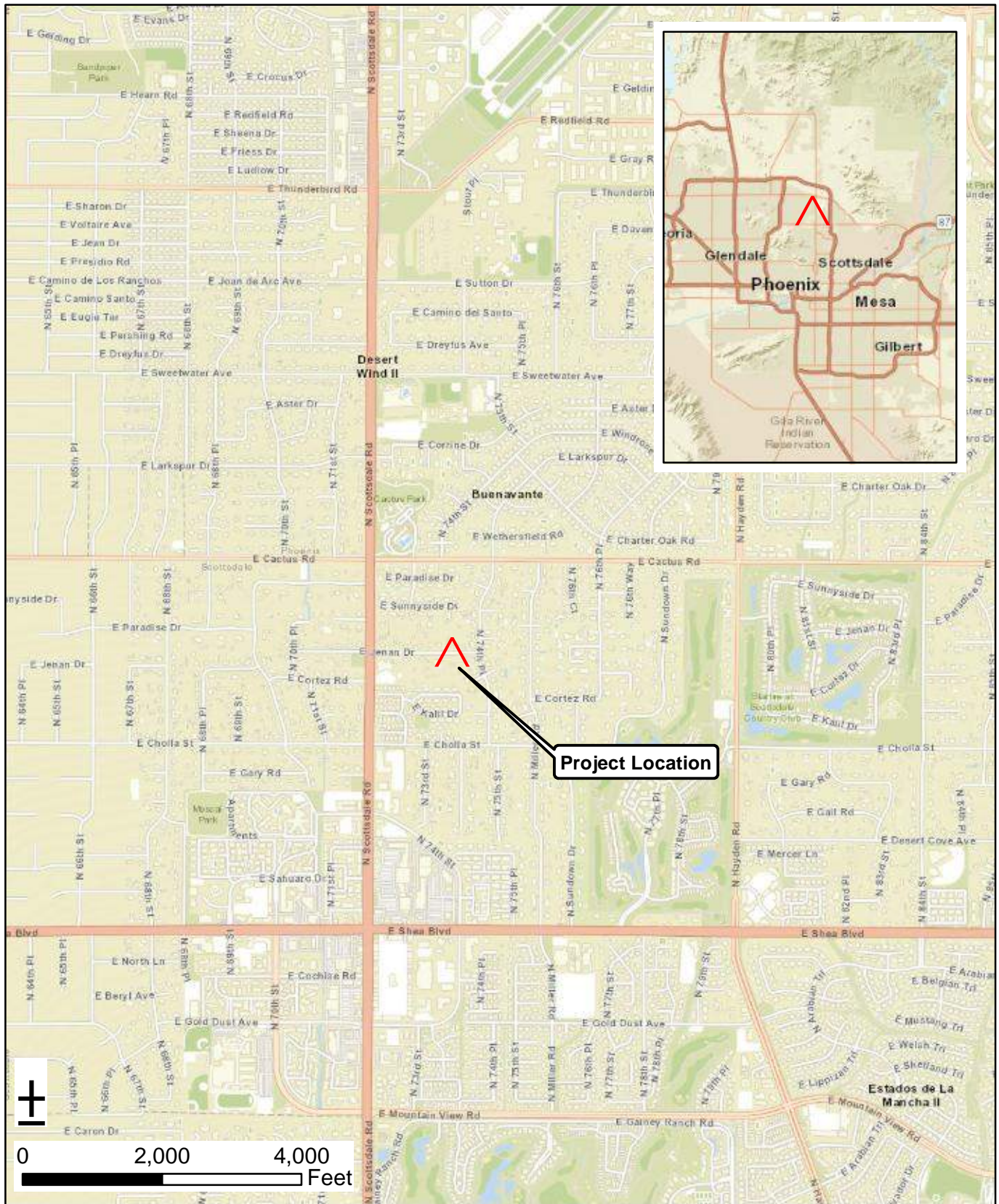
### PROJECT SIZE AND TYPE


The Site is a proposed 5.7-acre residential subdivision. The proposed development consists of 10 single-family residential units. Currently, the property is developed with single-family lots that are zoned R1-35. This report is being prepared to rezone the property to R1-10PRD. The proposed site is located within the City of Scottsdale (City).

### PURPOSE AND OBJECTIVES

This report establishes drainage parameters and criteria for site planning and zoning. This report establishes a general hydrologic and hydraulic plan for the development of the site and will include the following:

- Demonstrate compliance with the City's Design Standards & Policies Manual (DS&PM)
- Quantify offsite runoff being conveyed through the existing property
- Determine a preliminary hydrologic analysis for onsite and offsite runoff that meets the City's requirements
- Determine a preliminary hydraulic analysis for onsite and offsite runoff that meets the City's requirements



 <p>Expect More. Experience Better.</p>	Estates at Jenan		Scottsdale, AZ
	Figure 1. Location Map		

## DESCRIPTION OF EXISTING DRAINAGE CONDITIONS AND CHARACTERISTICS

### EXISTING ONSITE CONDITIONS

The Site consists of three developed single-family home lots zoned R1-35 in existing conditions. The Site slopes from northwest to southeast with an average slope of 0.8%. Offsite flow approaches the Site from the northern boundary and collects in the southeast corner of the Site in Retention Basin A. There is an existing block wall bordering the Site along the south property line that blocks runoff from exiting the site, causing the offsite runoff to pond against the wall. The recorded plat for the development to the south indicated that wall openings were to be constructed. No wall openings are currently present. Refer to Figure 3 for the Drainage Conditions Map.

### EXISTING OFFSITE DRAINAGE CONDITIONS

The majority of the offsite runoff originates north of the Site from a drainage area developed with single-family homes and zoned R1-35 and R1-18. This offsite runoff is conveyed through the offsite drainage area, to the Site, through side yard swales and across East Jenan Drive. As offsite runoff enters the Site, it continues to flow south and east to the southeast corner of the Site where it ponds due to the existing block wall on the property line. Refer to Figure 3 for the Drainage Conditions Map.

### CONTEXT RELATIVE TO ADJACENT PROJECTS AND IMPROVEMENTS

Offsite runoff crosses East Jenan Drive by overtopping the existing roadway which has no curb or gutter and dirt shoulders. Further development within the Site requires East Jenan Drive to be improved for the half street. Improvements to the Site will need to consider the properties upstream of East Jenan Drive and downstream of the Site per City requirements. The existing site experiences ponding in the southeast corner. Improvements associated with the Site improve or do not impact the adjacent properties.

### FLOOD HAZARD ZONES ON PROPERTY, FIRM MAPS

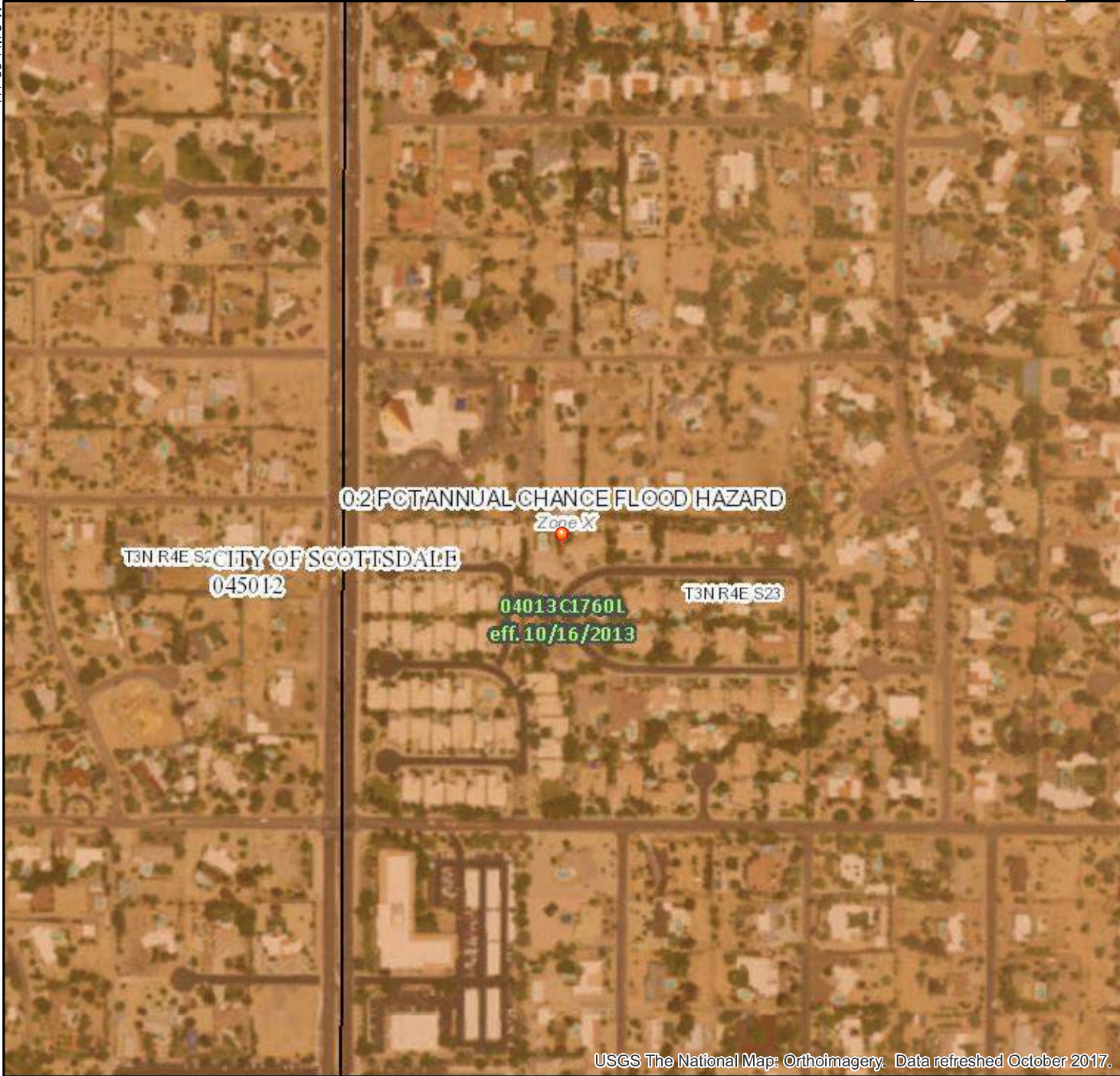
The Site is located within Flood Insurance Rate Map (FIRM) panel number 04013C1760L dated October 16, 2013. Refer to Figure 2 for a FIRMette of Panel 04013C1760L. The Site is in a shaded Zone X flood zone. Shaded Zone X flood zones are classified as "Areas of moderate flood hazard, usually between the limits of the 100-year and 500-year floods."



# National Flood Hazard Layer FIRMMette



33°35'44.87"N



USGS The National Map: Orthoimagery. Data refreshed October 2017. 1:6,000

## Legend

SEE FIS REPORT FOR DETAILED LEGEND AND INDEX MAP FOR FIRM PANEL LAYOUT

SPECIAL FLOOD HAZARD AREAS		Without Base Flood Elevation (BFE) Zone A, V, A99
		With BFE or Depth Zone AE, AO, AH, VE, AR
		Regulatory Floodway
OTHER AREAS OF FLOOD HAZARD		0.2% Annual Chance Flood Hazard, Areas of 1% annual chance flood with average depth less than one foot or with drainage areas of less than one square mile Zone X
		Future Conditions 1% Annual Chance Flood Hazard Zone X
		Area with Reduced Flood Risk due to Levee, See Notes, Zone X
		Area with Flood Risk due to Levee Zone D
OTHER AREAS		Area of Minimal Flood Hazard Zone X
		Effective LOMRs
		Area of Undetermined Flood Hazard Zone D
GENERAL STRUCTURES		Channel, Culvert, or Storm Sewer
		Levee, Dike, or Floodwall
OTHER FEATURES		20.2 Cross Sections with 1% Annual Chance Water Surface Elevation
		17.5 Cross Sections with 1% Annual Chance Water Surface Elevation
		Coastal Transect
		Base Flood Elevation Line (BFE)
		Limit of Study
		Jurisdiction Boundary
		Coastal Transect Baseline
MAP PANELS		Digital Data Available
		No Digital Data Available
		Unmapped



The pin displayed on the map is an approximate point selected by the user and does not represent an authoritative property location.

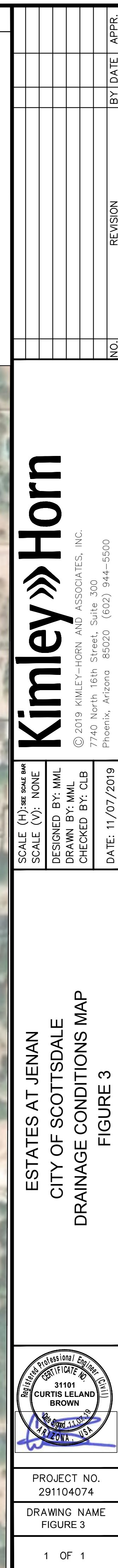
This map complies with FEMA's standards for the use of digital flood maps if it is not void as described below. The basemap shown complies with FEMA's basemap accuracy standards

The flood hazard information is derived directly from the authoritative NFHL web services provided by FEMA. This map was exported on 9/5/2018 at 5:23:50 PM and does not reflect changes or amendments subsequent to this date and time. The NFHL and effective information may change or become superseded by new data over time.

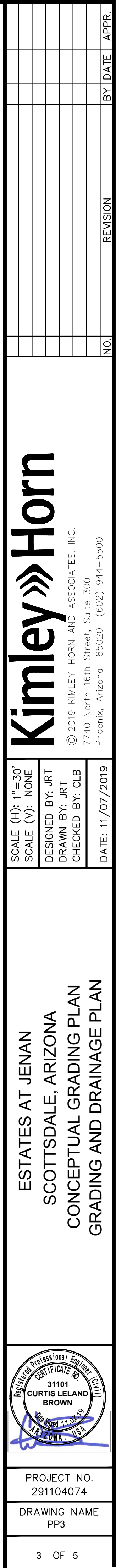
This map image is void if the one or more of the following map elements do not appear: basemap imagery, flood zone labels, legend, scale bar, map creation date, community identifiers, FIRM panel number, and FIRM effective date. Unmapped and unmodernized areas can regulatory purposes.

20-ZN-2018  
11/8/2019









## PROPOSED DRAINAGE PLAN

### PROPOSED ONSITE DRAINAGE PLAN

The proposed development consists of 10 single-family lots rezoned from R1-35 to R1-10. All proposed lots drain from the back of the lot forward to the local streets, which convey the runoff to Retention Basin A in the southeast corner of the Site. All lots will have finished floor elevations a minimum of one foot above the 100-year water surface elevations of Retention Basin A. Retention Basin A provides storage for onsite and offsite runoff and will drain via dry wells. The overall drainage pattern of the Site maintains the historical drainage pattern from northwest to southeast, and therefore, there is no outfall for offsite runoff to pass through the Site. Refer to Figure 3 for the Drainage Conditions Map.

### PROPOSED HYDROLOGY

Peak discharges are calculated using the Rational Method for the 2-year, 10-year, and 100-year storm events. Proposed onsite drainage areas are delineated from 1-foot contours. The offsite drainage area is delineated based on using City one-foot contours per quarter section mapping. All delineations are shown on the Drainage Conditions Map, Figure 3. Weighted “C” values were selected based on proposed zoning classifications per the DS&PM, and a minimum time of concentration of ten minutes was used. A summary of the peak discharges is provided in Table 1. Refer to Appendix A for the detailed hydrologic calculations.

Table 1. Peak Discharge

Drainage Area	Q <sub>2</sub> [cfs]	Q <sub>10</sub> [cfs]	Q <sub>100</sub> [cfs]
OFF10	13.9	24.2	38.3
ON10	2.0	3.2	5.0
ON20	1.3	2.0	3.2
ON30	0.9	1.5	2.3
ON40	4.3	7.0	11.0
ON50	0.4	0.7	1.1

### PROPOSED ONSITE HYDRAULICS

Offsite runoff approaches the Site from the north and is mixed with onsite runoff from proposed lots 1-3. There is 6” vertical curb proposed along East Jenan Drive with a low point at the entry of the Site to allow the runoff to discharge over the road to then be collected by the 2 MAG 533 Catch Basins 10 and 20. The catch basins with 36” pipes then discharge to a proposed 36” storm drain that routes the offsite runoff, plus runoff from proposed lots 1-3, to Retention Basin A in the southeast corner of the Site. Runoff has no outlet from the Site until elevation 1378.50, at which point runoff breaks out on to East Jenan Drive. At elevation 1379.50, runoff breaks out east on East Jenan Drive, providing the Ultimate Outfall for the Site and surrounding properties.



Onsite runoff will be conveyed in the local street to Catch Basins 30 and 40 to Retention Basin A. Per the DS&PM, all interior streets will be designed to convey the peak discharge from the 10-year storm event at or below the top of curb elevation. Additionally, the streets will convey the 100-year runoff within the proposed tracts and maintain a maximum flow depth of eight inches above the gutter flow line. Refer to Appendix B for the detailed hydraulic calculations.

## DATA ANALYSIS METHODS

### HYDROLOGY

The Rational Method is used to determine the 2-year, 10-year, and 100-year peak discharges for offsite and onsite drainage areas. The hydrology in this report uses rainfall depths from National Oceanic and Atmospheric Administration Atlas 14 (NOAA 14). Offsite drainage areas were delineated using City one-foot contours per quarter section mapping provided by the City. Onsite drainage areas are delineated using proposed one-foot contours. A minimum time of concentration of ten minutes was used per the Flood Control District of Maricopa County (FCDMC) Drainage Design Manual, Hydrology (DDMH), dated August 2013.

### HYDRAULICS

StormCAD is used to model the proposed 18" and 36" storm drains and is sized for the 100-year storm.

FlowMaster CONNECT Edition was used to determine the street capacity and inlet sizing for the Site. Catch Basins 10, 20, and 40 are designed with 17' wings on either side, in sump condition, sized to pass the 100-year runoff from OFF10 and ON10. Catch Basin 30 is designed with a 3' wing on the west, in sump condition, sized to pass the 100-year runoff from ON30.

### STORMWATER STORAGE METHOD

The proposed development is designed to retain the 100-year, 2-hour volume for both onsite and offsite runoff due to lack of outfall for the offsite runoff. Retention Basin A will retain 225% of the onsite runoff volumes for the 100-year, 2-hour storm event within 3.2 feet of basin depth. In addition to the 100-year, 2-hour volume provided for onsite runoff, Retention Basin A will also retain the onsite and offsite runoff volumes for the 100-year, 2-hour, 6-hour, and 24-hour storm events within 5.35 feet of depth. In existing conditions, the Site provides about 3 acre-feet of storage, resulting in no reduction in storage from existing to proposed conditions. Table 2 below summarizes the volumes for the onsite runoff in proposed conditions while Table 3 summarizes the volumes for the onsite plus offsite runoff in proposed conditions. Retention basin A will be drained via dual chamber dry wells that are designed to drain the 100-year, 2-hour storm within 36 hours, per the DS&PM.

Table 2. Proposed Onsite Volume Summary Table

Storm Event	Proposed Required Onsite Volume (AF)	Proposed Onsite Volume Provided (AF)
100 Yr, 2 Hr	0.8	1.8



Table 3. Proposed Onsite and Offsite Volume Summary Table

Storm Event	Proposed Onsite/Offsite Volume Produced (AF)	Proposed Onsite/Offsite Volume Provided (AF)
100 Yr, 2 Hr**	2.0	3.4
100 Yr, 6 Hr*	2.4	3.4
100 Yr, 24 Hr*	3.3	3.4

\*Offsite storage is not required per DS&PM.

\*\*Onsite 100-year, 2-hour storage is required per DS&PM.

## CONCLUSIONS

- In existing conditions offsite flows approach the site from the north, travel southeast through the site and pond against the block wall on the south property line of the Site. Wall openings included in the Final Plat were not constructed. Runoff has no outlet from the Site until elevation 1378.50, at which point runoff breaks out on to East Jenan Drive. At elevation 1379.50, runoff breaks out east on East Jenan Drive, providing the Ultimate Outfall for the Site and surrounding properties.
- Retention Basin A will be used to store onsite and offsite runoff due to the lack of outfall for the Site.
- Runoff volume generated by storms in excess of the 100-year, 2-hour event will be retained within the Site by additional depth above the basin high water elevations and below the finished floor elevations.
- Finished floor elevations will be set at a minimum of one foot above the 100-year water surface elevation and will not be impacted in storm events up to the 100-year, 24-hour. The lowest finished floor elevation is 1378.70, 0.2' above the Ultimate Site Outfall, and 0.80' below the Ultimate Outfall on East Jenan Drive.

This is the pad elevation for lot 5 per the submitted preliminary g/d plan.

Since there is no outfall, the development should evaluate the safety of floor elevations based on an extreme event. In the event of an extreme event or back to back larger events that completely filled the basin, would all of the proposed floor elevations be free from inundation? The plan appears to show an overflow in Jenan Drive at the northeast corner of the site at around 79.5 or so with the lot 5 floor elevation just a little below this elevation. The report should discuss this situation, verify the overflow elevation, and raise the lowest floor on lot 5 a minimum of 0.2 feet above the overflow elevation that would result from an extreme event.

## REFERENCES

City of Scottsdale, *Design Standards and Policies Manual*, 2018.

Federal Emergency Management Agency, Flood Insurance Rate Map Panel No 04013C1760L, dated October 16, 2013.

City of Scottsdale Topography Quarter Section Maps.

Flood Control District of Maricopa County, *Drainage Design Manual, Hydrology*, August 2013.

## Appendix A Hydrology

- *NOAA 14 Rainfall*
- *Rational Method Calculations*
- *Storage Calculations*

## Appendix A Hydrology

- *NOAA 14 Rainfall*

General Project Information			
Project	Estates at Jenan		
Project #	291104071		
Designed by	MML	Date	11/5/2019

NOAA 14 Rainfall Depth Data [in]										
	Storm Event [yr]									
Duration	1	2	5	10	25	50	100	200	500	1000
5-min:	0.19	0.25	0.33	0.40	0.49	0.55	0.63	0.70	0.79	0.86
10-min:	0.29	0.37	0.50	0.60	0.74	0.84	0.95	1.06	1.21	1.32
15-min:	0.35	0.46	0.62	0.75	0.92	1.05	1.18	1.31	1.49	1.63
30-min:	0.48	0.62	0.84	1.01	1.23	1.41	1.59	1.77	2.01	2.20
60-min:	0.59	0.77	1.04	1.25	1.53	1.74	1.97	2.19	2.49	2.72
2-hr:	0.69	0.89	1.19	1.41	1.73	1.96	2.20	2.45	2.78	3.03
3-hr:	0.77	0.99	1.29	1.53	1.86	2.13	2.41	2.70	3.10	3.42
6-hr:	0.93	1.17	1.50	1.76	2.11	2.38	2.67	2.96	3.36	3.68
12-hr:	1.03	1.30	1.64	1.90	2.26	2.54	2.82	3.11	3.49	3.79
24-hr:	1.21	1.53	1.97	2.32	2.80	3.19	3.58	4.00	4.57	5.02
2-day:	1.29	1.64	2.14	2.54	3.09	3.52	3.98	4.45	5.11	5.63
3-day:	1.37	1.75	2.30	2.74	3.36	3.86	4.38	4.93	5.71	6.33
4-day:	1.46	1.87	2.47	2.95	3.64	4.20	4.79	5.42	6.31	7.03
7-day:	1.65	2.11	2.79	3.34	4.13	4.76	5.43	6.14	7.15	7.97
10-day:	1.78	2.28	3.01	3.60	4.42	5.08	5.79	6.53	7.57	8.40
20-day:	2.20	2.83	3.74	4.43	5.36	6.07	6.80	7.54	8.54	9.31
30-day:	2.57	3.31	4.37	5.18	6.25	7.09	7.94	8.81	9.98	10.90
45-day:	2.96	3.82	5.04	5.94	7.13	8.02	8.93	9.84	11.00	11.90
60-day:	3.26	4.22	5.55	6.52	7.78	8.71	9.65	10.60	11.80	12.70

NOAA 14 Rainfall Intensity [in/hr]										
	Storm Event									
Duration	1	2	5	10	25	50	100	200	500	1000
5-min:	2.26	2.94	3.96	4.76	5.83	6.65	7.50	8.35	9.50	10.37
10-min:	1.72	2.24	3.02	3.62	4.44	5.06	5.71	6.36	7.26	7.92
15-min:	1.42	1.85	2.49	2.99	3.67	4.20	4.72	5.24	5.96	6.52
30-min:	0.95	1.25	1.68	2.02	2.46	2.82	3.18	3.54	4.02	4.40
60-min:	0.59	0.77	1.04	1.25	1.53	1.74	1.97	2.19	2.49	2.72
2-hr:	0.34	0.45	0.60	0.71	0.87	0.98	1.10	1.23	1.39	1.52
3-hr:	0.26	0.33	0.43	0.51	0.62	0.71	0.80	0.90	1.03	1.14
6-hr:	0.15	0.20	0.25	0.29	0.35	0.40	0.45	0.49	0.56	0.61
12-hr:	0.086	0.108	0.137	0.158	0.188	0.212	0.235	0.259	0.291	0.316
24-hr:	0.050	0.064	0.082	0.097	0.117	0.133	0.149	0.167	0.190	0.209
2-day:	0.027	0.034	0.045	0.053	0.064	0.073	0.083	0.093	0.106	0.117
3-day:	0.019	0.024	0.032	0.038	0.047	0.054	0.061	0.068	0.079	0.088
4-day:	0.015	0.020	0.026	0.031	0.038	0.044	0.050	0.057	0.066	0.074
7-day:	0.010	0.013	0.017	0.020	0.025	0.028	0.032	0.037	0.043	0.047
10-day:	0.007	0.010	0.013	0.015	0.018	0.021	0.024	0.027	0.032	0.035
20-day:	0.005	0.006	0.008	0.009	0.011	0.013	0.014	0.016	0.018	0.019
30-day:	0.004	0.005	0.006	0.007	0.009	0.010	0.011	0.012	0.014	0.015
45-day:	0.003	0.004	0.005	0.006	0.007	0.007	0.008	0.009	0.010	0.011
60-day:	0.002	0.003	0.004	0.005	0.005	0.006	0.007	0.007	0.008	0.009

## Appendix A Hydrology

- *Rational Method Calculations*

General Project Information			
Project	Estates at Jenan		
Designed by	MML	Date	11/5/2019
Design Storm Event	2		
Minimum $T_c$ [min]	10		

Drainage Area Information					Hydrology				
Drainage Area	Longitudinal Slope, $S_i$ [ft/ft]	Rational Coefficient <sup>1</sup>	Flowpath Length [ft]	Area [ac]	FCDMC Resistance Coefficient Type	$K_b$	$I$ [in/hr]	$T_c$ [min]	$Q$ [cfs]
OFF10	0.009	0.62	1,130	10.8	A	0.034	2.1	12.4	13.9
ON10	0.007	0.70	456	1.3	A	0.039	2.2	10.0	2.0
ON20	0.009	0.70	340	0.8	A	0.041	2.2	10.0	1.3
ON30	0.011	0.70	300	0.6	A	0.041	2.2	10.1	0.9
ON40	0.006	0.70	552	2.7	A	0.037	2.2	10.1	4.3
ON50	0.005	0.30	10	0.7	A	0.041	2.2	10.0	0.4

General Project Information			
Project	Estates at Jenan		
Designed by	MML	Date	11/5/2019
Design Storm Event	10		
Minimum $T_c$ [min]	10		

Drainage Area Information					Hydrology				
Drainage Area	Longitudinal Slope, $S_i$ [ft/ft]	Rational Coefficient <sup>1</sup>	Flowpath Length [ft]	Area [ac]	FCDMC Resistance Coefficient Type	$K_b$	$I$ [in/hr]	$T_c$ [min]	$Q$ [cfs]
OFF10	0.009	0.62	1,130	10.8	A	0.034	3.6	10.1	24.2
ON10	0.007	0.70	456	1.3	A	0.039	3.6	10.0	3.2
ON20	0.009	0.70	340	0.8	A	0.041	3.6	10.0	2.0
ON30	0.011	0.70	300	0.6	A	0.041	3.6	10.0	1.5
ON40	0.006	0.70	552	2.7	A	0.037	3.6	10.0	7.0
ON50	0.005	0.30	10	0.7	A	0.041	3.6	10.0	0.7



General Project Information			
Project	Estates at Jenan		
Designed by	MML	Date	11/5/2019
Design Storm Event		100	
Minimum $T_c$ [min]		10	

Drainage Area Information					Hydrology				
Drainage Area	Longitudinal Slope, $S_i$ [ft/ft]	Rational Coefficient <sup>1</sup>	Flowpath Length [ft]	Area [ac]	FCDMC Resistance Coefficient Type	$K_b$	$I$ [in/hr]	$T_c$ [min]	$Q$ [cfs]
OFF10	0.009	0.62	1,130	10.8	A	0.034	5.7	10.0	38.3
ON10	0.007	0.70	456	1.3	A	0.039	5.7	10.0	5.0
ON20	0.009	0.70	340	0.8	A	0.041	5.7	10.0	3.2
ON30	0.011	0.70	300	0.6	A	0.041	5.7	10.0	2.3
ON40	0.006	0.70	552	2.7	A	0.037	5.7	10.0	11.0
ON50	0.005	0.30	10	0.7	A	0.041	5.7	10.0	1.1

## Appendix A Hydrology

- *Storage Calculations*



General Project Information			
Project	Estates at Jenan		
Designed by	MML	Date	11/5/2019
Design Storm Event [yr]	100		

#### ON-SITE 100YR-2HR REQUIRED STORAGE

Storm Duration [hrs]	Area [ac]	Rational Coefficient <sup>1</sup>	Volume Required [ac-ft]	Basin Bottom Elev [ft]	Basin Top Elev [ft]	Basin Bottom Area [ft <sup>2</sup> ]	Basin Top Area [ft <sup>2</sup> ]	Basin Depth [ac-ft]	Volume Provided [ac-ft]	Discharge per Dry Well [cfs]	No. of Dry Wells	Drain Down Time [hrs]
2	6.05	0.70	0.8	1,372.9	1,376.1	22,435	27,781	3.20	1.8	0.30	1.00	31

1= Runoff coefficient per Scottsdale DSPM based on zoning category

General Project Information			
Project	Estates at Jenan		
Designed by	MML	Date	11/5/2019
Design Storm Event [yr]	100		

#### ON/OFF-SITE STORAGE

Storm Duration [hrs]	Area [ac] <sup>1</sup>	Rational Coefficient <sup>2</sup>	Volume Required [ac-ft]	Basin Bottom Elev [ft]	Basin Top Elev [ft]	Basin Bottom Area [ft <sup>2</sup> ]	Basin Top Area [ft <sup>2</sup> ]	Basin Depth [ac-ft]	Volume Provided [ac-ft]	Discharge per Dry Well [cfs]	No. of Dry Wells	Drain Down Time [hrs]
2	16.85	0.65	2.0	1,372.9	1,378.3	22,435	49,468	5.35	3.4	0.30	3.00	27
6	16.85	0.65	2.4	1,372.9	1,378.3	22,435	49,468	5.35	3.4	0.30	3.00	33
24	16.85	0.65	3.3	1,372.9	1,378.3	22,435	49,468	5.35	3.4	0.30	4.00	33

1=Offsite+onsite area (6.05 & 10.80)

2=Weighted C Value for offsite+onsite drainage area per Scottsdale DSPM based on zoning category (.62 & .70)

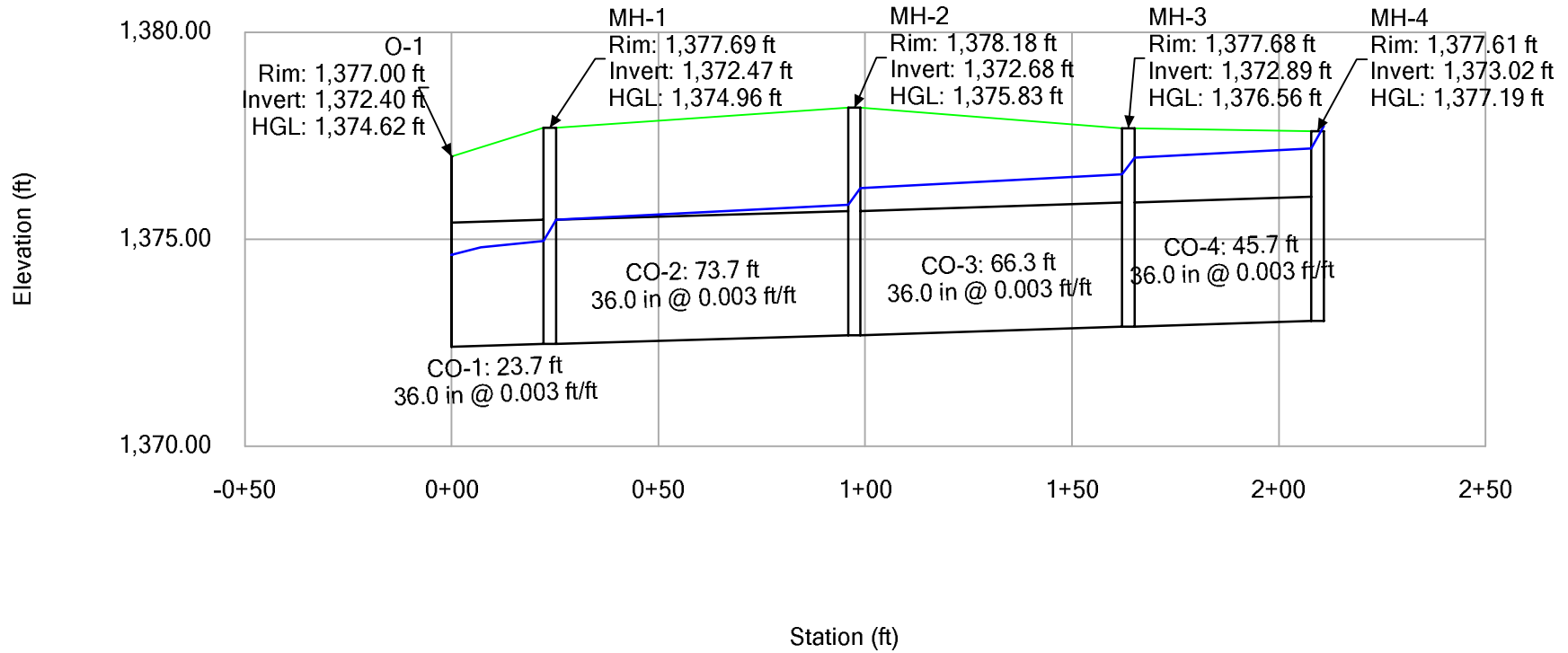
## Appendix B Hydraulics

- *StormCAD Calculations*
- *Street Capacity*
- *Inlet Calculations*

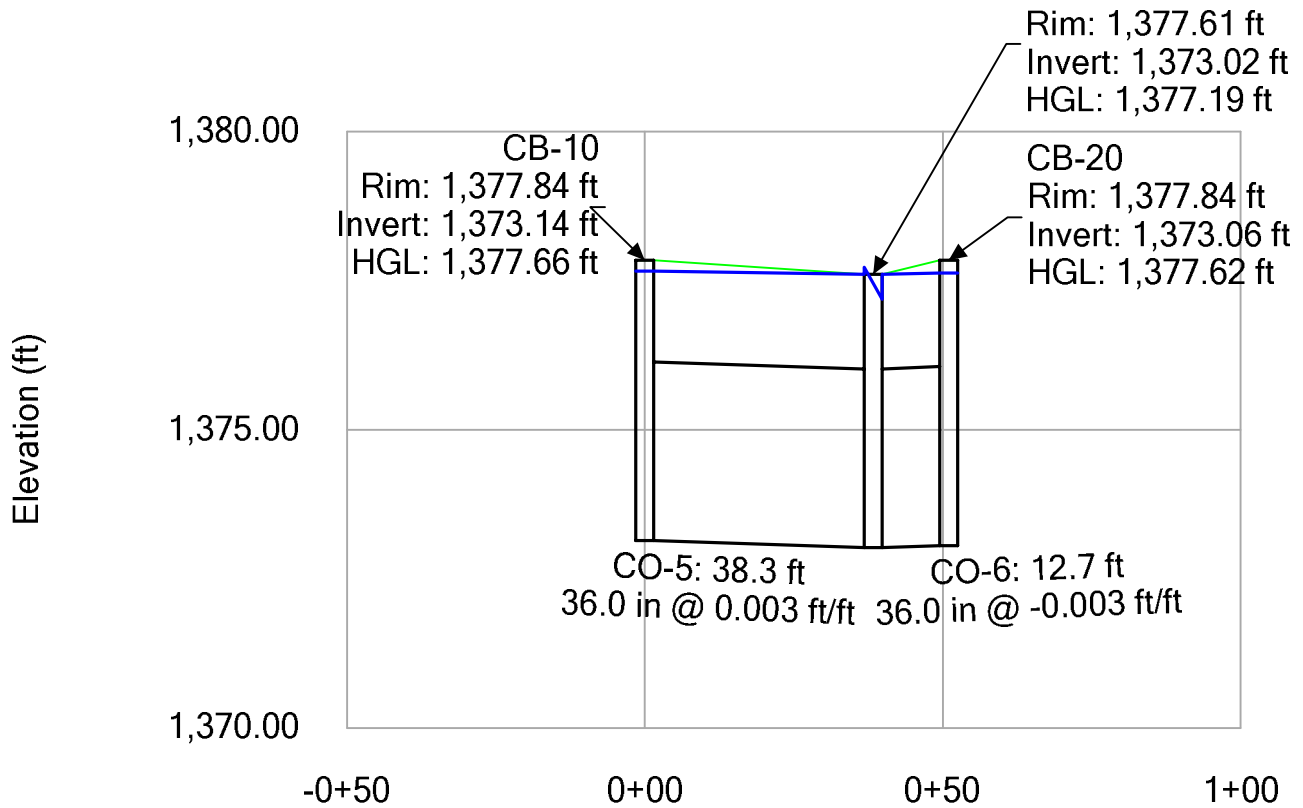
## Appendix B Hydraulics

- *StormCAD Calculations*

# Profile Report Engineering Profile - Main Storm Drain to RBA (Jenan.stsw)

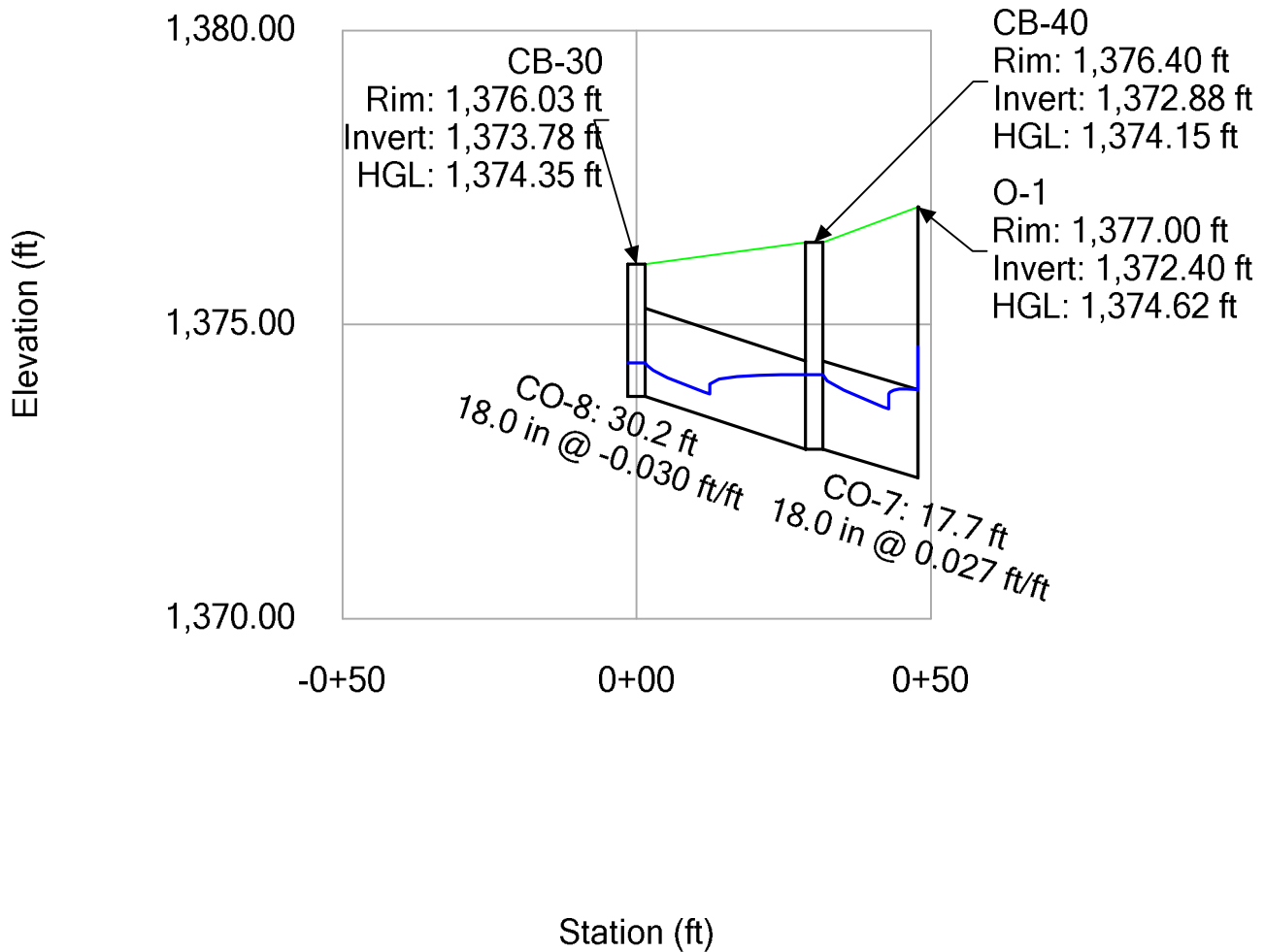


Profile Report  
Engineering Profile - Storm Drain at Entry (OFF10,ON10,ON20)  
(Jenan.stsw)





# Profile Report Engineering Profile - Storm Drain at RBA (ON30 and ON40) (Jenan.stsw)



## Appendix B Hydraulics

- *Street Capacity*

## Street Capacity - Entry at CB10 & CB20 - 10YR

Project Description	
Friction Method	Manning Formula
Solve For	Normal Depth
Input Data	
Channel Slope	0.005 ft/ft
Discharge	29.40 cfs

### Section Definitions

Station (ft)	Elevation (ft)
0+00.00	80.30
0+04.46	80.00
0+05.31	78.00
0+10.00	77.87
0+12.44	77.83
0+12.94	77.75
0+32.94	77.70
0+33.44	78.20
0+41.44	78.20
0+41.94	77.70
0+61.94	77.75
0+62.44	77.84
0+64.93	77.87
0+69.62	78.00
0+70.38	80.00
0+74.93	80.60

### Roughness Segment Definitions

Start Station	Ending Station	Roughness Coefficient
(0+00.00, 80.30)	(0+12.44, 77.83)	0.041
(0+12.44, 77.83)	(0+33.44, 78.20)	0.013
(0+33.44, 78.20)	(0+41.44, 78.20)	0.041
(0+41.44, 78.20)	(0+62.44, 77.84)	0.013
(0+62.44, 77.84)	(0+74.93, 80.60)	0.041

Options	
Current Roughness Weighted Method	Pavlovskii's Method
Open Channel Weighting Method	Pavlovskii's Method
Closed Channel Weighting Method	Pavlovskii's Method

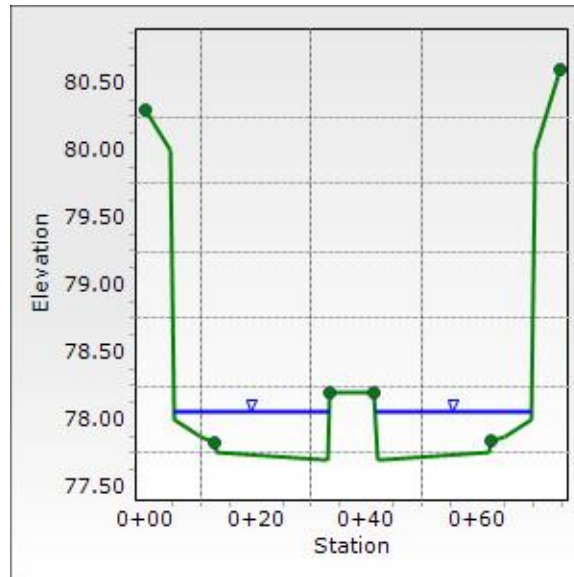
Results	
Normal Depth	4.2 in

## Street Capacity - Entry at CB10 & CB20 - 10YR

Results	
Elevation Range	77.70 to 80.60 ft
Flow Area	15.6 ft <sup>2</sup>
Wetted Perimeter	56.44 ft
Hydraulic Radius	3.3 in
Top Width	56.06 ft
Normal Depth	4.2 in
Critical Depth	3.3 in
Critical Slope	0.014 ft/ft
Velocity	1.89 ft/s
Velocity Head	0.06 ft
Specific Energy	0.41 ft
Froude Number	0.632
Flow Type	Subcritical
GVF Input Data	
Downstream Depth	0.0 in
Length	0.00 ft
Number Of Steps	0
GVF Output Data	
Upstream Depth	0.0 in
Profile Description	N/A
Profile Headloss	0.00 ft
Downstream Velocity	Infinity ft/s
Upstream Velocity	Infinity ft/s
Normal Depth	4.2 in
Critical Depth	3.3 in
Channel Slope	0.005 ft/ft
Critical Slope	0.014 ft/ft
Messages	
Messages	Flow is divided.
Notes	10YR Flow=OFF10 +ON10+ON2 0  =24.2+3.2+2 .0

## Cross Section for Street Capacity - Entry at CB10 & CB20 - 10YR

Project Description	
Friction Method	Manning Formula
Solve For	Normal Depth
Input Data	
Channel Slope	0.005 ft/ft
Normal Depth	4.2 in
Discharge	29.40 cfs



## Street Capacity - Entry at CB10 & CB20 - 100YR

Project Description	
Friction Method	Manning Formula
Solve For	Normal Depth
Input Data	
Channel Slope	0.005 ft/ft
Discharge	46.50 cfs

### Section Definitions

Station (ft)	Elevation (ft)
0+00.00	80.30
0+04.46	80.00
0+05.31	78.00
0+10.00	77.87
0+12.44	77.83
0+12.94	77.75
0+32.94	77.70
0+33.44	78.20
0+41.44	78.20
0+41.94	77.70
0+61.94	77.75
0+62.44	77.84
0+64.93	77.87
0+69.62	78.00
0+70.38	80.00
0+74.93	80.60

### Roughness Segment Definitions

Start Station	Ending Station	Roughness Coefficient
(0+00.00, 80.30)	(0+12.44, 77.83)	0.041
(0+12.44, 77.83)	(0+33.44, 78.20)	0.013
(0+33.44, 78.20)	(0+41.44, 78.20)	0.041
(0+41.44, 78.20)	(0+62.44, 77.84)	0.013
(0+62.44, 77.84)	(0+74.93, 80.60)	0.041

### Options

Current Roughness Weighted Method	Pavlovskii's Method
Open Channel Weighting Method	Pavlovskii's Method
Closed Channel Weighting Method	Pavlovskii's Method

### Results

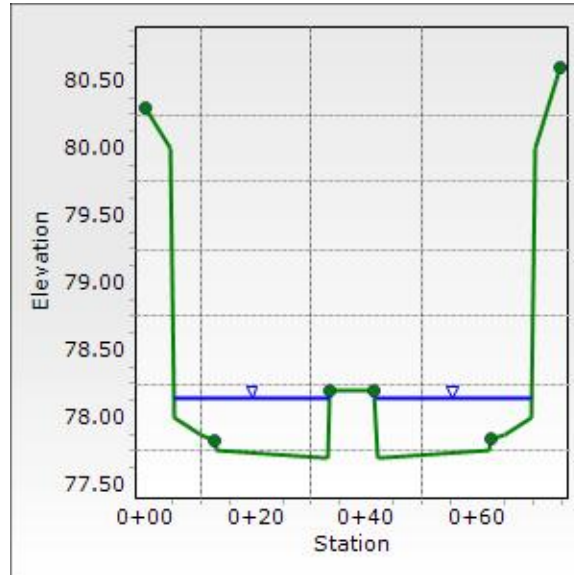
Normal Depth	5.3 in
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## Street Capacity - Entry at CB10 & CB20 - 100YR

Results	
Elevation Range	77.70 to 80.60 ft
Flow Area	20.6 ft <sup>2</sup>
Wetted Perimeter	56.88 ft
Hydraulic Radius	4.3 in
Top Width	56.31 ft
Normal Depth	5.3 in
Critical Depth	4.2 in
Critical Slope	0.013 ft/ft
Velocity	2.26 ft/s
Velocity Head	0.08 ft
Specific Energy	0.52 ft
Froude Number	0.659
Flow Type	Subcritical
GVF Input Data	
Downstream Depth	0.0 in
Length	0.00 ft
Number Of Steps	0
GVF Output Data	
Upstream Depth	0.0 in
Profile Description	N/A
Profile Headloss	0.00 ft
Downstream Velocity	Infinity ft/s
Upstream Velocity	Infinity ft/s
Normal Depth	5.3 in
Critical Depth	4.2 in
Channel Slope	0.005 ft/ft
Critical Slope	0.013 ft/ft
Messages	
Messages	Flow is divided.
Notes	100YR Flow=OFF10 +ON10+ON2 0  =38.3+5.0+3 .2

## Cross Section for Street Capacity - Entry at CB10 & CB20 - 100YR

Project Description	
Friction Method	Manning
	Formula
Solve For	Normal Depth
Input Data	
Channel Slope	0.005 ft/ft
Normal Depth	5.3 in
Discharge	46.50 cfs





## Street Capacity - Knuckle East of CB30 & CB40 - 10YR

Project Description	
Friction Method	Manning
Solve For	Formula
	Normal Depth
Input Data	
Channel Slope	0.005 ft/ft
Discharge	8.50 cfs

### Section Definitions

Station (ft)	Elevation (ft)
0+00.00	78.69
0+10.00	78.08
0+16.00	77.99
0+18.00	77.67
0+30.00	77.90
0+42.00	77.66
0+44.00	77.99
0+50.00	78.19
0+60.00	78.53

### Roughness Segment Definitions

Start Station	Ending Station	Roughness Coefficient
(0+00.00, 78.69)	(0+16.00, 77.99)	0.041
(0+16.00, 77.99)	(0+44.00, 77.99)	0.013
(0+44.00, 77.99)	(0+60.00, 78.53)	0.041

Options	
Current Roughness Weighted Method	Pavlovskii's Method
Open Channel Weighting Method	Pavlovskii's Method
Closed Channel Weighting Method	Pavlovskii's Method

Results	
Normal Depth	3.2 in
Elevation Range	77.66 to 78.69 ft
Flow Area	3.9 ft <sup>2</sup>
Wetted Perimeter	27.26 ft
Hydraulic Radius	1.7 in
Top Width	27.21 ft
Normal Depth	3.2 in
Critical Depth	3.2 in
Critical Slope	0.005 ft/ft
Velocity	2.20 ft/s

## Street Capacity - Knuckle East of CB30 & CB40 - 10YR

### Results

Velocity Head	0.08 ft
Specific Energy	0.34 ft
Froude Number	1.028
Flow Type	Supercritical

### GVF Input Data

Downstream Depth	0.0 in
Length	0.00 ft
Number Of Steps	0

### GVF Output Data

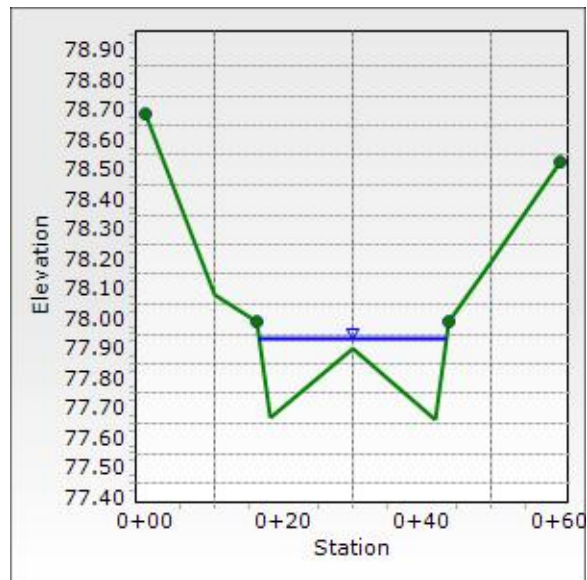
Upstream Depth	0.0 in
Profile Description	N/A
Profile Headloss	0.00 ft
Downstream Velocity	Infinity ft/s
Upstream Velocity	Infinity ft/s
Normal Depth	3.2 in
Critical Depth	3.2 in
Channel Slope	0.005 ft/ft
Critical Slope	0.005 ft/ft

### Messages

Notes	10YR Flow=ON30+ ON40  =1.5+7.0
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## Cross Section for Street Capacity - Knuckle East of CB30 & CB40 - 10YR

Project Description	
Friction Method	Manning
	Formula
Solve For	Normal Depth
Input Data	
Channel Slope	0.005 ft/ft
Normal Depth	3.2 in
Discharge	8.50 cfs



## Street Capacity - Knuckle East of CB30 & CB40 - 100YR

Project Description	
Friction Method	Manning
Solve For	Formula
	Normal Depth
Input Data	
Channel Slope	0.005 ft/ft
Discharge	13.30 cfs

### Section Definitions

Station (ft)	Elevation (ft)
0+00.00	78.69
0+10.00	78.08
0+16.00	77.99
0+18.00	77.67
0+30.00	77.90
0+42.00	77.66
0+44.00	77.99
0+50.00	78.19
0+60.00	78.53

### Roughness Segment Definitions

Start Station	Ending Station	Roughness Coefficient
(0+00.00, 78.69)	(0+16.00, 77.99)	0.041
(0+16.00, 77.99)	(0+44.00, 77.99)	0.013
(0+44.00, 77.99)	(0+60.00, 78.53)	0.041

Options	
Current Roughness Weighted Method	Pavlovskii's Method
Open Channel Weighting Method	Pavlovskii's Method
Closed Channel Weighting Method	Pavlovskii's Method

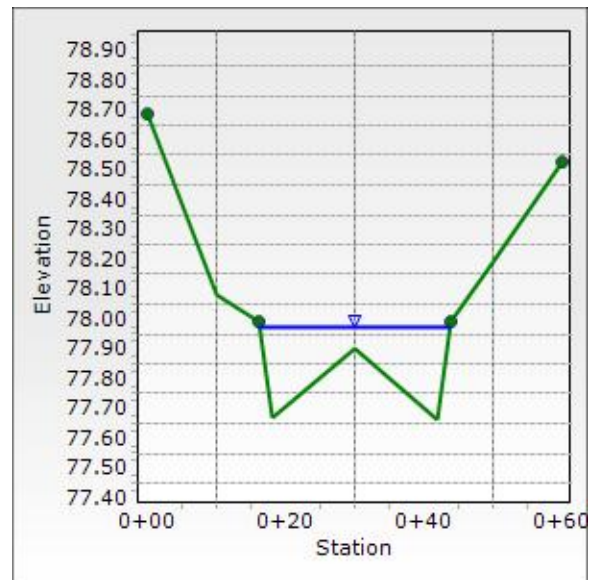
Results	
Normal Depth	3.7 in
Elevation Range	77.66 to 78.69 ft
Flow Area	5.1 ft <sup>2</sup>
Wetted Perimeter	27.82 ft
Hydraulic Radius	2.2 in
Top Width	27.77 ft
Normal Depth	3.7 in
Critical Depth	3.8 in
Critical Slope	0.004 ft/ft
Velocity	2.61 ft/s

## Street Capacity - Knuckle East of CB30 & CB40 - 100YR

Results	
Velocity Head	0.11 ft
Specific Energy	0.42 ft
Froude Number	1.071
Flow Type	Supercritical
GVF Input Data	
Downstream Depth	0.0 in
Length	0.00 ft
Number Of Steps	0
GVF Output Data	
Upstream Depth	0.0 in
Profile Description	N/A
Profile Headloss	0.00 ft
Downstream Velocity	Infinity ft/s
Upstream Velocity	Infinity ft/s
Normal Depth	3.7 in
Critical Depth	3.8 in
Channel Slope	0.005 ft/ft
Critical Slope	0.004 ft/ft
Messages	
Notes	100YR Flow=ON30+ ON40  =2.3+11.0

## Cross Section for Street Capacity - Knuckle East of CB30 & CB40 - 100YR

Project Description	
Friction Method	Manning
	Formula
Solve For	Normal Depth
Input Data	
Channel Slope	0.005 ft/ft
Normal Depth	3.7 in
Discharge	13.30 cfs



## Street Capacity - Knuckle West of CB30 & CB40 - 10YR

Project Description	
Friction Method	Manning
Solve For	Formula
	Normal Depth
Input Data	
Channel Slope	0.005 ft/ft
Discharge	8.50 cfs

### Section Definitions

Station (ft)	Elevation (ft)
0+00.00	79.00
0+10.00	78.00
0+16.00	77.91
0+18.00	77.58
0+30.00	77.78
0+42.00	77.58
0+44.00	77.91
0+50.00	78.00
0+60.00	78.87

### Roughness Segment Definitions

Start Station	Ending Station	Roughness Coefficient
(0+00.00, 79.00)	(0+16.00, 77.91)	0.041
(0+16.00, 77.91)	(0+44.00, 77.91)	0.013
(0+44.00, 77.91)	(0+60.00, 78.87)	0.041

Options	
Current Roughness Weighted Method	Pavlovskii's Method
Open Channel Weighting Method	Pavlovskii's Method
Closed Channel Weighting Method	Pavlovskii's Method

Results	
Normal Depth	2.9 in
Elevation Range	77.58 to 79.00 ft
Flow Area	3.9 ft <sup>2</sup>
Wetted Perimeter	27.02 ft
Hydraulic Radius	1.7 in
Top Width	26.97 ft
Normal Depth	2.9 in
Critical Depth	3.0 in
Critical Slope	0.005 ft/ft
Velocity	2.21 ft/s

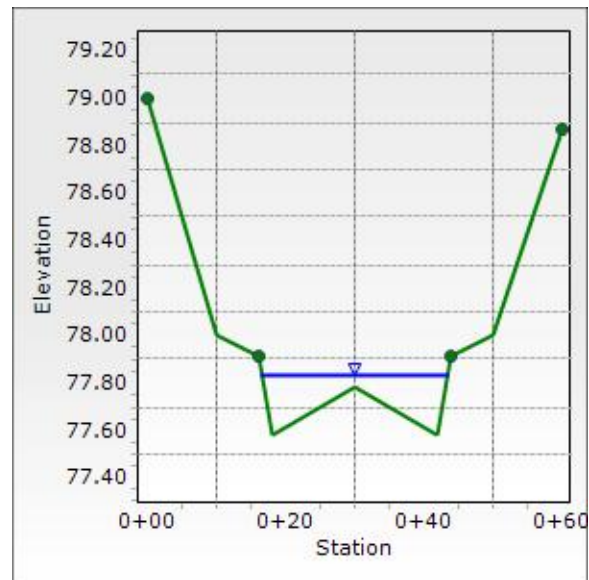
## Street Capacity - Knuckle West of CB30 & CB40 - 10YR

Results	
Velocity Head	0.08 ft
Specific Energy	0.32 ft
Froude Number	1.029
Flow Type	Supercritical
GVF Input Data	
Downstream Depth	0.0 in
Length	0.00 ft
Number Of Steps	0
GVF Output Data	
Upstream Depth	0.0 in
Profile Description	N/A
Profile Headloss	0.00 ft
Downstream Velocity	Infinity ft/s
Upstream Velocity	Infinity ft/s
Normal Depth	2.9 in
Critical Depth	3.0 in
Channel Slope	0.005 ft/ft
Critical Slope	0.005 ft/ft
Messages	
Notes	10YR Flow=ON30+ ON40  =1.5+7.0



# Cross Section for Street Capacity - Knuckle West of CB30 & CB40 - 10YR

Project Description	
Friction Method	Manning
	Formula
Solve For	Normal Depth
Input Data	
Channel Slope	0.005 ft/ft
Normal Depth	2.9 in
Discharge	8.50 cfs



## Street Capacity - Knuckle West of CB30 & CB40 - 100YR

Project Description	
Friction Method	Manning
Solve For	Formula
	Normal Depth
Input Data	
Channel Slope	0.005 ft/ft
Discharge	13.30 cfs

### Section Definitions

Station (ft)	Elevation (ft)
0+00.00	79.00
0+10.00	78.00
0+16.00	77.91
0+18.00	77.58
0+30.00	77.78
0+42.00	77.58
0+44.00	77.91
0+50.00	78.00
0+60.00	78.87

### Roughness Segment Definitions

Start Station	Ending Station	Roughness Coefficient
(0+00.00, 79.00)	(0+16.00, 77.91)	0.041
(0+16.00, 77.91)	(0+44.00, 77.91)	0.013
(0+44.00, 77.91)	(0+60.00, 78.87)	0.041

Options	
Current Roughness Weighted Method	Pavlovskii's Method
Open Channel Weighting Method	Pavlovskii's Method
Closed Channel Weighting Method	Pavlovskii's Method

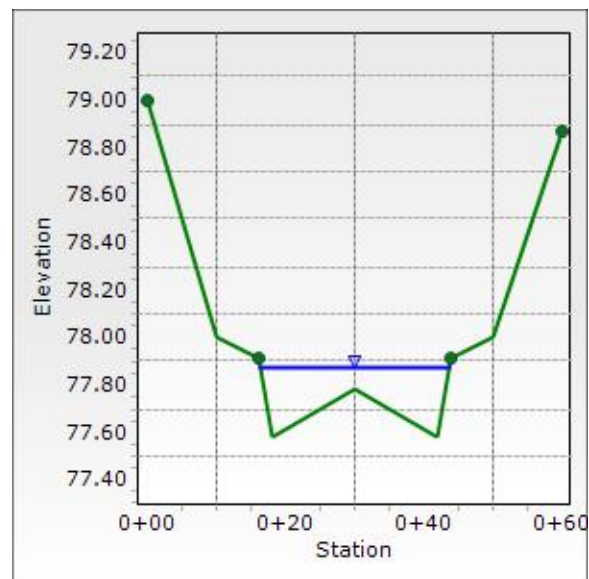
Results	
Normal Depth	3.5 in
Elevation Range	77.58 to 79.00 ft
Flow Area	5.1 ft <sup>2</sup>
Wetted Perimeter	27.57 ft
Hydraulic Radius	2.2 in
Top Width	27.52 ft
Normal Depth	3.5 in
Critical Depth	3.6 in
Critical Slope	0.004 ft/ft
Velocity	2.62 ft/s

## Street Capacity - Knuckle West of CB30 & CB40 - 100YR

Results	
Velocity Head	0.11 ft
Specific Energy	0.40 ft
Froude Number	1.074
Flow Type	Supercritical
GVF Input Data	
Downstream Depth	0.0 in
Length	0.00 ft
Number Of Steps	0
GVF Output Data	
Upstream Depth	0.0 in
Profile Description	N/A
Profile Headloss	0.00 ft
Downstream Velocity	Infinity ft/s
Upstream Velocity	Infinity ft/s
Normal Depth	3.5 in
Critical Depth	3.6 in
Channel Slope	0.005 ft/ft
Critical Slope	0.004 ft/ft
Messages	
Notes	100YR Flow=ON30+ ON40  =1.3+11.0

## Cross Section for Street Capacity - Knuckle West of CB30 & CB40 - 100YR

Project Description	
Friction Method	Manning
	Formula
Solve For	Normal Depth
Input Data	
Channel Slope	0.005 ft/ft
Normal Depth	3.5 in
Discharge	13.30 cfs



## Appendix B Hydraulics

- *Inlet Calculations*

## Worksheet for CB10 - 100YR

<b>Project Description</b>	
Solve For	Spread
<b>Input Data</b>	
Discharge	28.98 cfs
Gutter Width	1.42 ft
Gutter Cross Slope	0.030 ft/ft
Road Cross Slope	0.020 ft/ft
Curb Opening Length	37.00 ft
Opening Height	0.50 ft
Curb Throat Type	Horizontal
Local Depression	2.0 in
Local Depression Width	24.0 in
Throat Incline Angle	90.00 degrees
<b>Results</b>	
Spread	20.42 ft
Depth	5.1 in
Gutter Depression	0.2 in
Total Depression	2.2 in
<b>Messages</b>	
Notes	Clogging Factor of 20% X 0.5OFF10+O N10 Flow 1.2 (0.5*38.3+5. 0)

## Worksheet for CB20 - 100YR

<b>Project Description</b>	
Solve For	Spread
<b>Input Data</b>	
Discharge	26.82 cfs
Gutter Width	1.42 ft
Gutter Cross Slope	0.030 ft/ft
Road Cross Slope	0.020 ft/ft
Curb Opening Length	37.00 ft
Opening Height	0.50 ft
Curb Throat Type	Horizontal
Local Depression	2.0 in
Local Depression Width	24.0 in
Throat Incline Angle	90.00 degrees
<b>Results</b>	
Spread	19.40 ft
Depth	4.8 in
Gutter Depression	0.2 in
Total Depression	2.2 in
<b>Messages</b>	
Notes	Clogging Factor of 20% X 0.5OFF10+O N20 Flow 1.2 (0.5*38.3+3. 2)

## Worksheet for CB30 - 100YR

Project Description	
Solve For	Curb Opening Length
Input Data	
Discharge	2.76 cfs
Spread	13.50 ft
Gutter Width	1.42 ft
Gutter Cross Slope	0.030 ft/ft
Road Cross Slope	0.020 ft/ft
Opening Height	0.50 ft
Curb Throat Type	Horizontal
Local Depression	2.0 in
Local Depression Width	24.0 in
Throat Incline Angle	90.00 degrees
Results	
Curb Opening Length	4.95 ft
Depth	3.4 in
Gutter Depression	0.2 in
Total Depression	2.2 in
Messages	
Notes	Clogging Factor of 20% X Flow



## Worksheet for CB40 - 100YR

<b>Project Description</b>	
Solve For	Curb Opening Length
<b>Input Data</b>	
Discharge	13.20 cfs
Spread	13.50 ft
Gutter Width	1.42 ft
Gutter Cross Slope	0.030 ft/ft
Road Cross Slope	0.020 ft/ft
Opening Height	0.50 ft
Curb Throat Type	Horizontal
Local Depression	2.0 in
Local Depression Width	24.0 in
Throat Incline Angle	90.00 degrees
<b>Results</b>	
Curb Opening Length	31.36 ft
Depth	3.4 in
Gutter Depression	0.2 in
Total Depression	2.2 in
<b>Messages</b>	
Notes	Clogging Factor of 20% X ON40 Flow 1.2*(11.0)